APPENDIX E

Biological Survey/Monitoring Report for the Santa Maria Creek Restoration Project: arroyo toads (Hollingsworth et al. 2006)

Biological Survey/Monitoring Report for the Santa Maria Creek Restoration Project:

Arroyo Toads

Prepared for:
County of San Diego
Department of Parks and Recreation
5201 Ruffin Road, Suite P
San Diego, CA 92123
Contact: Jennifer Haines

Prepared by:
Bradford D. Hollingsworth, Ph.D.
San Diego Natural History Museum
and
Christina M. Schaefer
Mark Roll

On behalf of:
Technology Associates (TAIC)
9089 Clairemont Mesa Blvd, Suite 307
San Diego, CA 92123
Contact: Christina Schaefer

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Introduction

The presence of the federally endangered arroyo toad (*Bufo californicus*) within the Ramona Grasslands Preserve (RGP) has been documented in the past and is known to occur in a limited stretch of Santa Maria Creek (Varanus Biological Services, Inc. 2004; Gergus 1994). The Santa Maria Creek traverses the RGP in an east to west direction for a length of approximately 4.5 miles (7.25 km). Arroyo toads occupy the western, downstream section of the creek in a narrow, flat-bottomed, low gradient stretch of the streambed for a distance of about 1.0 mile (1.6 km).

Directed sight surveys were conducted in May and June of 2006 to confirm the presence of toads in known areas, evaluate the 2006 breeding season, document disturbance, and explore the length of the Santa Maria Creek within the preserve to determine the presence or absence of toads in unreported areas.

Project Location

Surveys were conducted within a core preserve area known as the Ramona Grasslands Preserve (RGP). RGP is located in the vicinity of the Santa Maria Creek and the Ramona Airport in the western portion of the community of Ramona, San Diego County, California. The preserve area includes properties currently owned by The Nature Conservancy, including the former Cagney Ranch, the Hardy property, Oak Country Estates, and Eagle Ranch. Adjacent landowners, including Wildlife Research Institute (WRI), selected Voorhes Lane properties, Cumming Ranch, the County's Ramona Airport open space, Hobbs, Martz, and the Ramona Water District were given the opportunity to take part in this project. Only properties with landowner consent were included in project activities.

Most of the properties have been used as livestock pasturage, but were formerly part of a large expanse of native grassland. These locations have been identified by the proposed North County Multiple Species Conservation Program (MSCP) Subarea Plan as areas of very high quality habitat and, as such, have been included in the planned preserve area.

Project Description

The County of San Diego Department of Parks and Recreation was awarded a Proposition 13 Grant by the California Water Resources Control Board for the Santa Maria Creek Protection and Restoration Project. The purpose of the grant is to protect and restore Santa Maria Creek and its adjacent watershed areas within the Ramona Grasslands Preserve, the project area, (hereinafter referred to as "Ramona Grasslands"), to improve water quality and habitat conditions in the creek corridor. Santa Maria Creek has been subjected to unmanaged cattle grazing, which has resulted in elevated suspended sediment concentrations, bacteria, and nutrients in the stream. In addition,

increasing urbanization in the town of Ramona, upstream of the project area, has contributed urban, non-point source runoff to the stream. Land uses upstream of the Ramona Grasslands are largely rural residential, but development densities are projected to increase in the future according to General Plan 2020 of the County of San Diego. The Santa Maria Creek Protection and Restoration Project will prevent residential development in the Ramona Grasslands, thus eliminating a future source of urban runoff to Santa Maria Creek and downstream receiving waters. The project will also manage cattle grazing by limiting access of livestock to the creek corridor with fencing, thus eliminating a source of agricultural pollutants and allowing stabilization of the channel and restoration of riparian and wetland vegetation to enhance riverine functions in the creek system.

A second component of the project consists of collecting baseline biological data, which will facilitate preserve management decision-making and track responses to management actions to refine recommended monitoring protocols. Baseline data will enable preserve managers to:

- Measure the success of the non-native plant species removal and restoration program.
- Measure changes in the physical condition and hydrology of the creek, ephemeral aquatic habitats (vernal pools, vernal swale, and alkali playas) and their watersheds.
- Track changes in the current distribution and abundance of management target species.
- Understand the distribution of non-native animal species.
- Provide a benchmark to which all subsequent monitoring data can be compared, realizing that the "typical" and historic conditions of the Grasslands are unknown.

The target species selected for the baseline surveys are the arroyo toad (*Bufo californicus*), riparian bird species, raptors, and Stephens' kangaroo rat (*Dipodomys stephensi*). In addition, vernal pools were surveyed for fairy shrimp, amphibians, and plant species. Grassland floral surveys and vegetation transects across Santa Maria Creek were also performed. The following sections describe the methods and results of the baseline arroyo toad surveys in the spring of 2006 that were conducted by herpetologists Bradford Hollingsworth and Angelo-Soto Centeno from the San Diego Natural History Museum and Mark Roll from TAIC. The significance of these results and recommendations for future monitoring will be discussed as well.

Methods

Day and nighttime directed sight surveys were conducted on 31 May 2006 and 12 June 2006 following the guidelines of the U.S. Fish and Wildlife Service (1999), augmented with recommendations from United States Geological Survey (USGS 2003; additional USGS survey protocols in preparation). Surveys traversed the RGP in nine reaches from downstream to upstream (Table 1, Figs. 1-2). Two to three biologists walked along the edge or within the creek to detect the presence or absence of arroyo toads. Surveys were confined to the erosion contours of the creek bed. Upland habitats beyond the banks of stream channel were not surveyed.

Data were recorded on datasheets (see Appendix I) and in field notebooks to document life stage, time, location, habitat, air and water/substrate temperatures, and signs of disturbance. Photographic vouchers were recorded for all sight records provided the animal's position allowed for photography (Appendix II). Locations were recorded with a handheld Garmin Legend GPS unit using an accuracy reading of six meters or less. A handheld Coleman lantern, a Canon high intensity video light, and headlamps assisted nighttime surveys.

Results

During the two survey dates, arroyo toads were detected in Reaches 1-5 in the Santa Maria Creek (Appendix II, Table 2, Fig. 1). A total of 11 adults were observed and the presence of a number of tadpoles and toadlets provides evidence of successful breeding. Two locations contained toadlets (=neonates) representing five individual observations, and five general locations had tadpoles (=larvae) representing 13 individual observations (Table 2). No toads (adults, toadlets, tadpoles, egg strings, or calls) were detected in Reaches 6-9, which corresponds to the reaches of creek from 0.7 miles NW of the Rangeland Road to the eastern margins of the RGP in Ramona.

Only three areas were identified with both adult toads and either tadpoles or toadlets (or both). The first location is in Reach 1 (11S 504980 3656519), located in a riparian corridor with large coast live oak (*Quercus agrifolia*), cottonwoods (*Populus fremontii*), and sycamores (*Platanus racemosa*). This location is in the most northwestern section of the creek where toads were seen. The creek at this location has the underlying bedrock exposed and large open pools are prevalent. The second location is in Reach 2 (11S 504748 3656374), located in a large sweeping northeastern bend in the creek with a large, exposed, elevated sandy shoulder. Mulefat (*Baccharis salicifolia*) is common here and the creek is a shallow, intermittent stream. The third location is in Reach 5 (11S 504948 3655652), located at the crossing of a dirt service road through the creek. This site consists of a large, still pool with sandy banks and bottom. The upstream portion of the pool is vegetated and approximately 2 ft deep, while the downstream portion becomes open and shallow, from 2-5 inches deep.

Overall, within Reaches 1-5 of the Santa Maria Creek, no flow could be detected within the stream and most surface water was in shallow open pools, vegetated pools, or in marshy, heavily vegetated sections. Open pool depth was between 2-3 feet deep. The total length of stream where arroyo toads were observed measures 0.75 miles (1.2 km).

Adult toads were detected in Reaches 1, 2, and 5, mostly using upland habitat within the erosion banks of the stream channel, from 10-30 meters from the stream water. On 31 May 2006, four adults were observed 10-20 meters from the stream in sandy soils. On 12 June 2006, seven adults were observed; one submerged in the water at the large open pond beginning Reach 5 and the remaining six in Reach 2, usually associated with sandy soils 10-30 meters from the stream. Adult activity was confined to the nighttime hours from 9:00-11:56 pm and air temperatures ranging from 10.4-20.1˚C.

Toadlets (=neonates) were observed in Reaches 2 and 5 associated with wet, sandy soils adjacent to surface water. On 31 May 2006, a single toadlet was observed along the downstream margin of the large pond beginning Reach 5. On 12 June 2006, approximately 10-15 toadlets were observed at the same pond and a single toadlet at a location in Reach 2. Toadlets were observed from 5:38-10:00pm during both day and nighttime surveys, with air temperatures ranging from 17.3-26.1˚C.

Tadpoles (=larvae) were observed in Reaches 1-5 during both day and nighttime surveys. The majority of tadpoles were observed in the large open pond beginning Reach 5. On 31 May 2006, a large number (200-300) of tadpoles were observed along the shallow margins of the pond. On 12 June 2006, a large number of slightly larger tadpoles were again seen at this same location. Only one other location, in Reach 1, contained a large number of tadpoles. On 31 May 2006, approximately 200-300 tadpoles were observed in an open shallow section of stream in Reach 1; however, on 12 June 2006 this section had dried and no tadpoles could be found in the adjacent deeper pools. Tadpole observations in Sections 2-4 were limited to either single individuals or small numbers and often associated with heavily vegetated, shallow sections of stream. Most tadpoles appeared to be early-stage (stage <32; see Fig. 3d), except in two cases. In Reaches 2 and 3, tadpoles (Table 2: 03 and 05) appeared to be late-stage with the formation of hindlimbs and well-differentiated digits (stage 36-40; see Fig. 3c). Tadpoles were found in water temperatures ranging from 18.2-30.0˚C.

A great number of exotic species were observed co-inhabiting the stream with arroyo toads. The most prevalent were bullfrogs (*Rana catesbeiana*), but crayfish (*Procambarus clarkii*), mosquitofish (*Gambusia affinis*), young-of-year largemouth bass (*Micropterus salmoides*), and green sunfish (*Lepomis cyanellus*) were also seen (Fig. 4). Bullfrogs were seen from Reach 1 to the downstream margin of Reach 6. All life-stages were observed in large numbers, including calling adult males, froglets, metamorphs, and tadpoles. Besides from the presence of exotic species, the second-most noticeable disturbance was trampling by cattle.

Native herpetofauna species seen during the surveys include pacific treefrog (*Pseudacris regilla*), western toad (*Bufo boreas*), two-striped garter snake (*Thamnophis hammondii*), and California kingsnake (*Lampropeltis getula*) (Appendix III).

Discussion

Arroyo toads (*Bufo californicus*) are present and successfully bred in 2006 from a short section of the Santa Maria Creek in the Ramona Grasslands Preserve. Adults, toadlets, and tadpoles were observed during the course of day and nighttime surveys in late May and mid-June. Due to the late dates of these surveys, other signs of reproduction, including calling males, amplexus, and egg deposition, were not detected. However, the presence of tadpoles (both early and late stage) and toadlets provide evidence of a successful 2006 breeding season.

The presence of toads along the downstream, western section of the creek has been documented by previous surveys in 2003 and 2005 (Varanus Biological Services, Inc. 2004; RECON Environmental, Inc. 2005). During the 2005 breeding season, surveys conducted between 16 March 2005 and 14 June 2005 detected toads (observation and/or vocalization) at five locations on the Oak Country Estates Property, west of Rangeland Road. Detections moved further westward toward the western boundary of the Oak Country Estates Property as the breeding season progressed. The westward movement of toads observed during 2005 surveys is consistent with observations from the current surveys. Arroyo toad locations reported in 2003 correspond closely with the observations made during these surveys. During the 2003 breeding season, males called on both 15 March 2003 and 27 March 2003, and amplexus was observed on both dates. Tadpoles were seen on 27 March 2003 and toadlets emerged on 13 June 2003. Adults began using upland habitat, within the stream channel, starting on 18 April 2003. Observations from the current surveys match closely. A single toadlet was first seen on 31 May 2006 and more appeared during the 12 June 2006 survey. Early and late-stage tadpoles persist and nearly all adults were seen in upland habitats, typically 10-30 meters from the stream.

One exception is the presence of adults, toadlets, and tadpoles at the large, still pool with sandy banks at the beginning of Reach 5 (11S 504948 3655652). In 2003, surveys did not find evidence of breeding at this location, but instead, found breeding pools further to the west (Varanus Biological Services, Inc. 2004). As a consequence, the presence of breeding at this location breaks the reported trend of the westward movement of breeding sites, away from Rangeland Road. The pool is located east of the 2003 breeding sites at a crossing of a dirt service road and is excavated by ranchers in order to provide a watering area for cattle (Mike White, pers. comm., 2006).

No records of arroyo toads east of Rangeland Road exist. Surveys in Reaches 7-9 found a progression of a marshy stream filled with rushes (*Juncus* sp.) at the Rangeland Road bridge to a dry, sandy riparian corridor extending past the Voorhes Lane properties to the eastern margin of the RGP. Varanus Biological Services, Inc. (2004) reports that this section of the Santa Maria Creek did not have sufficient surface water to support breeding

from 1998 to 2003. Considering the emergence of toadlets in mid-June in both 2003 and 2006 in the western sections of the creek, the lack of surface water would be a limiting factor to tadpole survival to the time of metamorphosis. Besides from the lack of surface water, the current surveys found the sandy, streambed conditions to be suitable arroyo toad habitat.

Besides from issues of hydrology, additional habitat disturbances within the current arroyo toad population make conditions for breeding and successful recruitment less than ideal. The most pressing threat is the large quantities of introduced bullfrogs (*Rana catesbeiana*) seen throughout the arroyo toad population. No effort was made to scientifically quantify the number of bullfrogs present. However, the number is easily in the thousands within the 0.75 mile (1.2 km) section of creek that contains arroyo toads. Bullfrog adults, froglets, metamorphs, and tadpoles were common throughout Reaches 1-5, and extend into the beginning of Reach 6. Three museum vouchers were collected (SDSNH 72589, 72590, and 72599). Bullfrogs are known to be aggressive predators. Varanus Biological Services, Inc. (2004) reports the palpation of an arroyo toad from the stomach of a bullfrog on 27 March 2003.

Removal of this introduced predator could improve arroyo toad habitat and increase the success of recruitment. Three arroyo toad breeding centers were detected along the 0.75 mile (1.2 km) section of creek during the current surveys. In comparable regions, arroyo toad densities can be ten calling males/100m or 100/km (Sweet and Sullivan 2005). While surveys were not conducted during calling season, the 2003 surveys report nine calling males on 15 March 2003 over a 300 meter section of creek (Varanus Biological Services, Inc. 2004). As a result, the overall breeding success in the Santa Maria Creek is substantially less than ideal.

Eradication of bullfrogs requires the detection of source and satellite populations due to this species ability to travel long distances across dry land. It is unknown if the Santa Maria Creek serves as the source population or if it is a satellite population. If the latter, the detection of the source population would be necessary before bullfrog eradication could commence. Candidate source populations include the two Ramona Municipal Water District treatment ponds located as close as 0.10 miles (0.16 km) to Santa Maria Creek. During the 2006 surveys, neither of these ponds were visited and it is unknown if bullfrogs occur there. Other introduced species detected during the course of the 2006 surveys are crayfish (*Procambarus clarkii*), mosquitofish (*Gambusia affinis*), largemouth bass (*Micropterus salmoides*), and green sunfish (*Lepomis cyanellus*). These should be considered for eradication as well.

Additional disturbances include the trampling of the streambed and upland habitat by cattle. Cattle trampling is visually unpleasant, yet it is unknown if this disturbance has an adverse effect on arroyo toads. Cattle grazing may provide a positive influence on the creek, by keeping vegetation from choking out the streambed (Mike White, pers. comm., 2006).

Future Monitoring Recommendations

We recommend continual monitoring of the arroyo toad population in the Santa Maria Creek and to implement the following actions and management policies:

• Assess breeding density and success. We suggest that annual surveys should start in early March and continue through June, in two week intervals, to detect the full breeding cycle, from the onset of calling to the emergence of toadlets. Pit-tagging adult individuals would allow mark and recapture methods to be used. Special attention should be paid to calling male densities to allow for meaningful comparisons year after year.

• Determine extent of creek use. We suggest that the downstream extent of the population be determined to have a better understanding of the distribution and survival of the species in this region. To date, the upstream extent of the population is well-known and its absence from sections of the Santa Maria Creek east of Rangeland Road investigated. No effort has been made to assess the extent of the population downstream. There is evidence that arroyo toad is present downstream from the study area, which is indicated by the presence of suitable habitat for approximately 1.2 miles beyond the study area boundary and the presence of arroyo toad (toad 10) at the terminus of the downstream study area boundary.

• Assess upland habitat use. We suggest that the extent of upland habitat use be assessed and should start in April and continue through October. Pit-tagging adult individuals would allow mark and recapture methods to be used. Pit-fall trapping with drift-net fences should be placed at incrementally distant locations to assess the extent of upland habitat use.

• Eradicate introduced species. We suggest that an annual eradication program be implemented to reduce the numbers of bullfrogs, crayfish and exotic fish. Aggressive removal of bullfrogs prior to their breeding season should reduce pressures caused by tadpole competition and adult bullfrog predation on toads.

• Determine source population for bullfrogs and control. Survey potential source populations within a 5 km area for bullfrogs and implement an eradication program. If possible, source populations should be fenced with tight-nit mesh to a height of 5 feet.

• Investigate the effects of cattle. Develop an experimental plot to exclude cattle from a subsection of the creek. Plant community composition should be evaluated prior to fencing to determine if cattle grazing has an effect on vegetation and hydrology.

• Excavate new ponds upstream. Create manmade surface water habitats in sandy reaches of the creek to extend the arroyo toad population upstream. Currently, arroyo toads use a manmade pool in Reach 5 of this study and have bred successfully in these habitats. Attempts to duplicate this shallow pool should be made.

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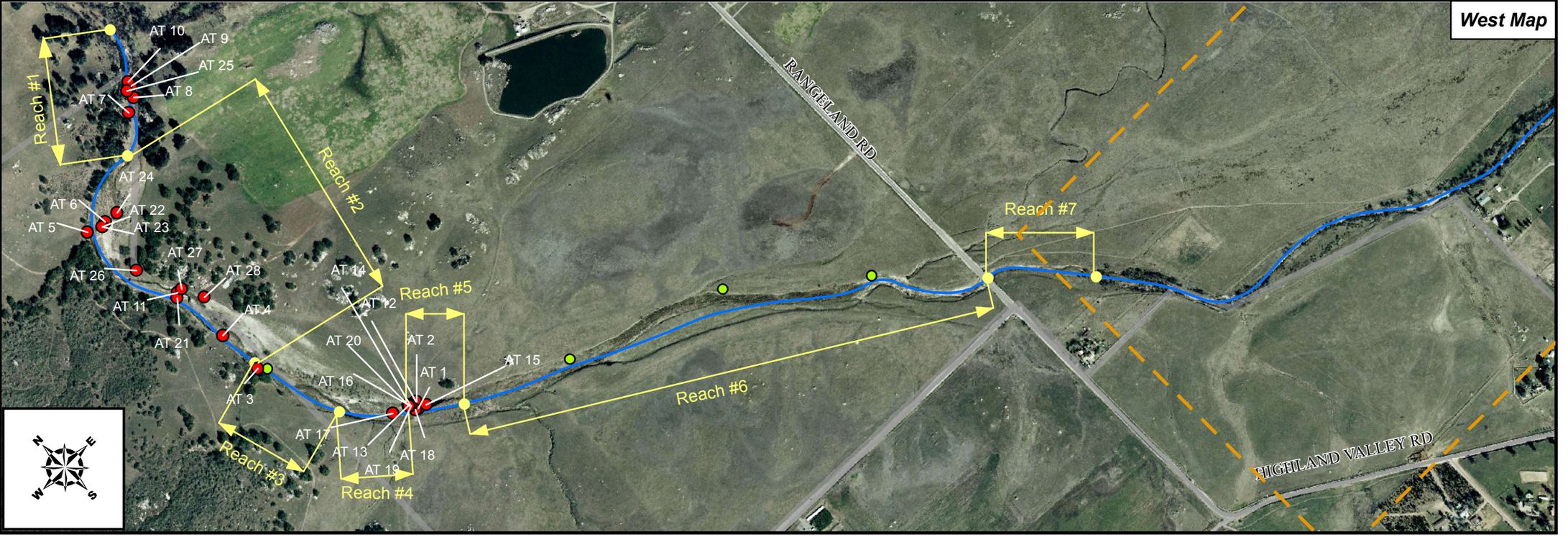
Table 1: Description of Santa Maria Creek transects used during directed sight surveys.

Reach	Length (m)	UTM Region	UTM Easting	UTM Northing	Elevation (m)	Habitat	Stream Condition
Reach 1	280	11S	505058	3656653	379	Riparian corridor with large oak and sycamore	Open still ponds (some 1-2 meters deep)
Reach 2	650	11S	504888	3656439	398	Open riparian with mulefat	Still intermittent stream
Reach 3	210	11S	504768	3655954	399	Open riparian with mulefat	Marshy stream
Reach 4	160	11S	504828	3655763	402	Open riparian with mulefat	Still intermittent stream
Reach 5	100	11S	504939	3655672	406	Open riparian with mulefat	Open still stream with manmade pond
Reach 6	1130	11S	505031	3655607	401	Open riparian with mulefat	Marshy intermittent stream, with small pond
Reach 7	240	11S	505971	3655026	412	Open riparian with willow and rushes (*Juncus* sp.)	Marshy stream
Reach 8	2250	11S	506145	3654879	411	Riparian corridor with large oak and sycamore	Dry
Reach 9	1450	11S	508111	3654359	414	Open riparian corridor with oak and sycamore	Dry
End	n/a	11S	509281	3654864	419	Ends in Ramona neighborhood	Dry

Table 2. Arroyo Toad localities during 2006 surveys along the Santa Maria Creek in the Ramona Grasslands Preserve.

Toad Sighting	UTM Region	UTM Easting	UTM Northing	Elev (m)	Date	Time	Life Stage	Reach
01a*	11S	504948	3655652	404	31-May-2006	5:38pm	Tadpoles (300+)	Reach #5
01b	11S	504948	3655652	404	31-May-2006	5:38pm	Toadlet (1)	Reach #5
02*	11S	504956	3655664	401	31-May-2006	9:13pm	Tadpoles (~10)	Reach #5
03	11S	504771	3655943	404	31-May-2006	9:58pm	Tadpoles (~6)	Reach #3
04*	11S	504767	3656040	402	31-May-2006	10:12pm	Tadpole (1)	Reach #2
05	11S	504718	3656388	389	31-May-2006	10:47pm	Tadpole (1)	Reach #2
06	11S	504759	3656378	388	31-May-2006	10:55pm	Adult (1)	Reach #2
07	11S	504951	3656503	380	31-May-2006	11:12pm	Adult (1)	Reach #1
08	11S	504980	3656519	389	31-May-2006	11:19pm	Tadpoles (300+)	Reach #1
09	11S	504993	3656539	398	31-May-2006	11:26pm	Tadpoles (~10)	Reach #1
10	11S	504996	3656549	395	31-May-2006	11:32pm	Adult (1)	Reach #1
11	11S	504763	3656169	396	31-May-2006	11:56pm	Adult (1)	Reach #2
12*	11S	504954	3655666	406	12-Jun-2006	6:15pm	Tadpoles (50-100)	Reach #5
13	11S	504938	3655670	404	12-Jun-2006	6:20pm	Tadpoles (200-300)	Reach #5
14	11S	504941	3655669	404	12-Jun-2006	6:30pm	Toadlet (1)	Reach #5
15*	11S	504965	3655646	411	12-Jun-2006	7:00pm	Tadpoles (~20)	Reach #5
16	11S	504939	3655671	411	12-Jun-2006	7:15pm	Toadlets (10-15)	Reach #5
17*	11S	504904	3655682	400	12-Jun-2006	8:45pm	Tadpole (1)	Reach $4
18*	11S	504942	3655654	406	12-Jun-2006	8:45pm	Tadpoles (200-300)	Reach #5
19*	11S	504942	3655666	401	12-Jun-2006	9:00pm	Adult (1)	Reach #5
20	11S	504938	3655669	398	12-Jun-2006	9:03pm	Toadlet (3)	Reach #5
21	11S	504754	3656161	413	12-Jun-2006	9:35pm	Adult (1)	Reach #2
22	11S	504748	3656374	400	12-Jun-2006	10:00pm	Adult (1)	Reach #2
23	11S	504748	3656374	400	12-Jun-2006	10:00pm	Toadlet (1)	Reach #2
24	11S	504790	3656374	395	12-Jun-2006	10:10pm	Adult (1)	Reach #2
25	11S	504980	3656537	400	12-Jun-2006	10:30pm	Tadpole (2)	Reach #1
26	11S	504735	3656261	392	12-Jun-2006	10:50pm	Adult (1)	Reach #2
27	11S	504774	3656169	397	12-Jun-2006	11:00pm	Adult (1)	Reach #2
28	11S	504796	3656124	395	12-Jun-2006	11:05pm	Adult (1)	Reach #2

*no photographic voucher taken, see Appendix II for skipped numbers.



Feet

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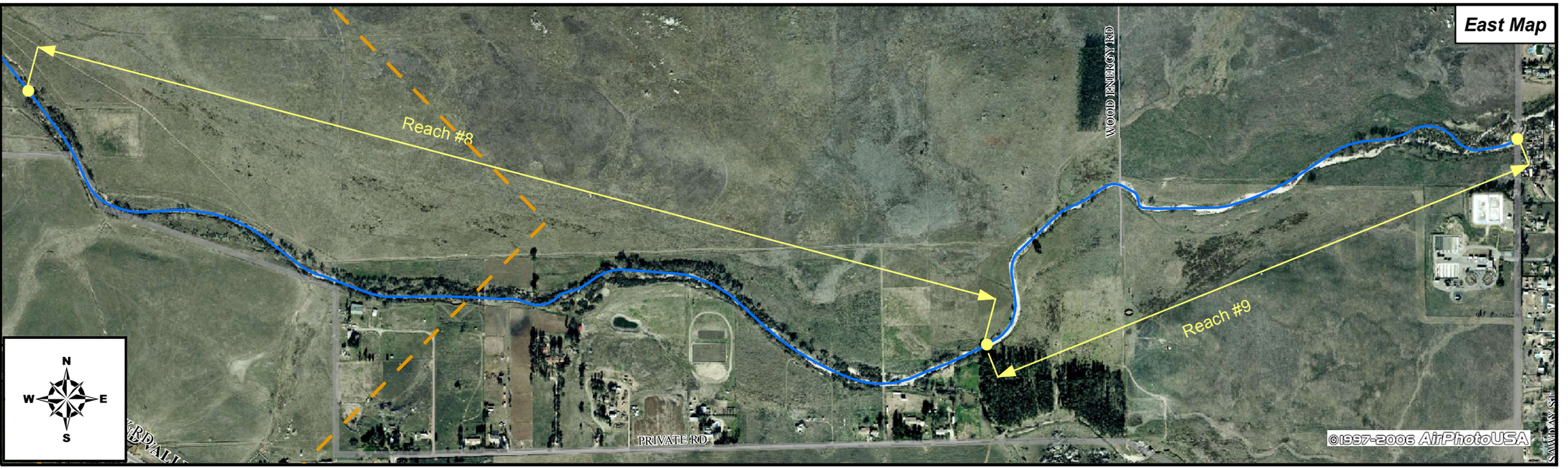


Figure 1: Arroyo toad survey reaches 1-9 and 2005/2006 survey results.

Legend

- Proposition 13 Project Area
- Arroyo Toad (2006)
- Arroyo Toad (2005)
- Surveyed Reaches
- Reach Division Endpoint
- Adjacent Map Boundary

Technology Associates
INTERNATIONAL CORPORATION

Document: Split_ArroyoToad.mxd

Date: Dec 15, 2006

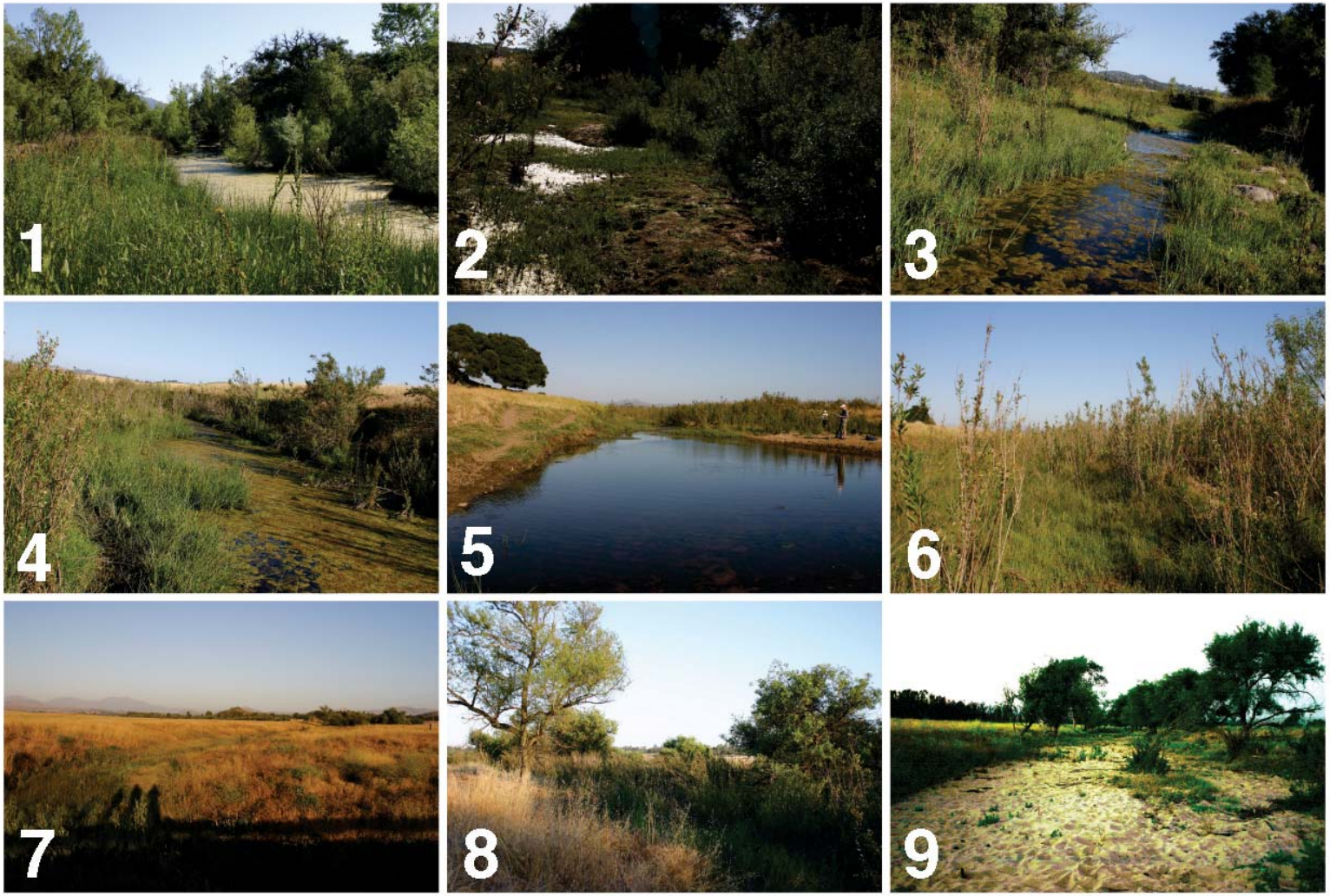


Figure 2. Habitats of survey stretches, Stretches 1-9 (see Table 1), in Santa Maria Creek.

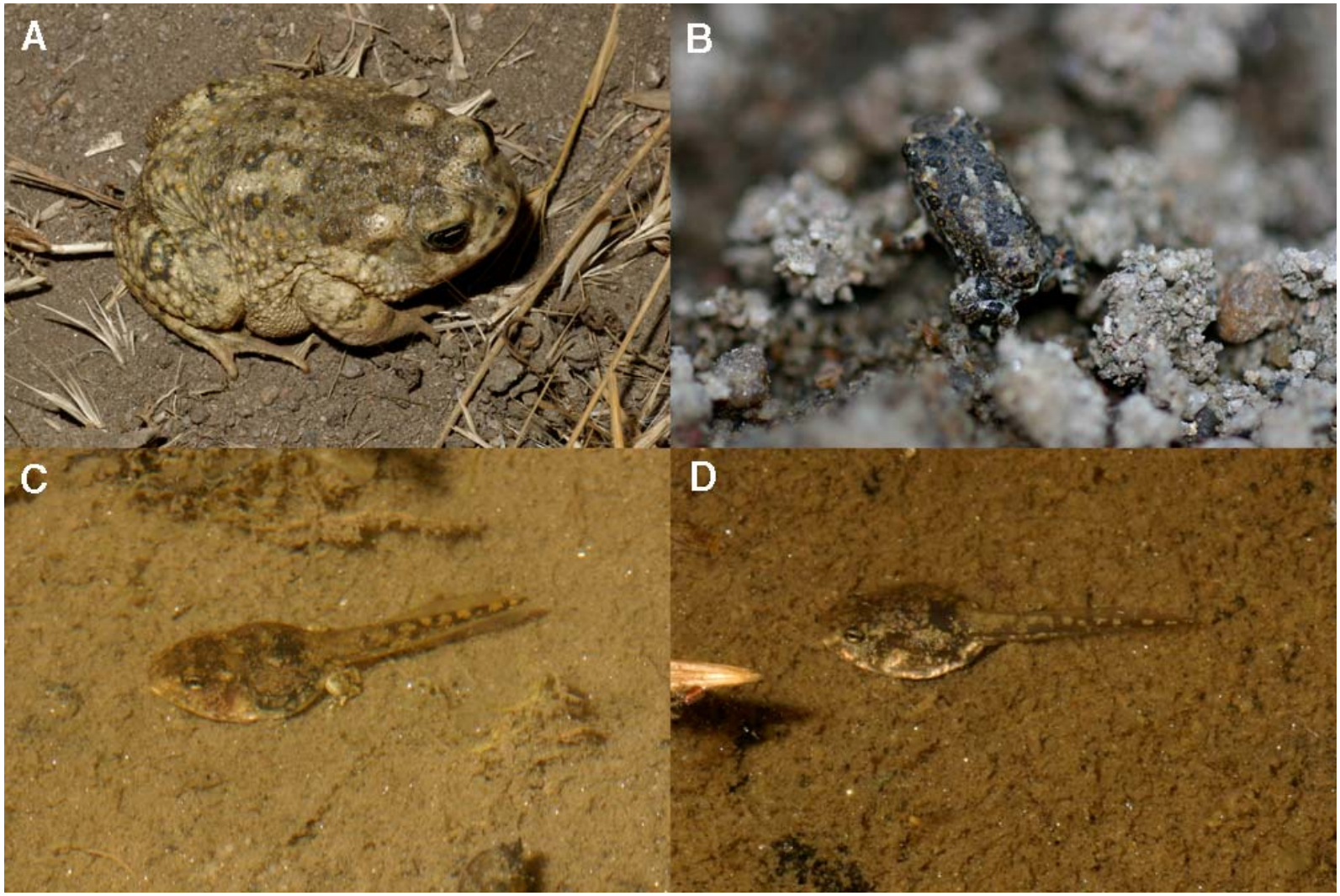


Figure 3. Arroyo Toad life stages observed during 2006 surveys: a) adult in upland habitat; b) toadlet in moist, sandy soil; c) late-stage tadpole; and d) early-stage tadpole.

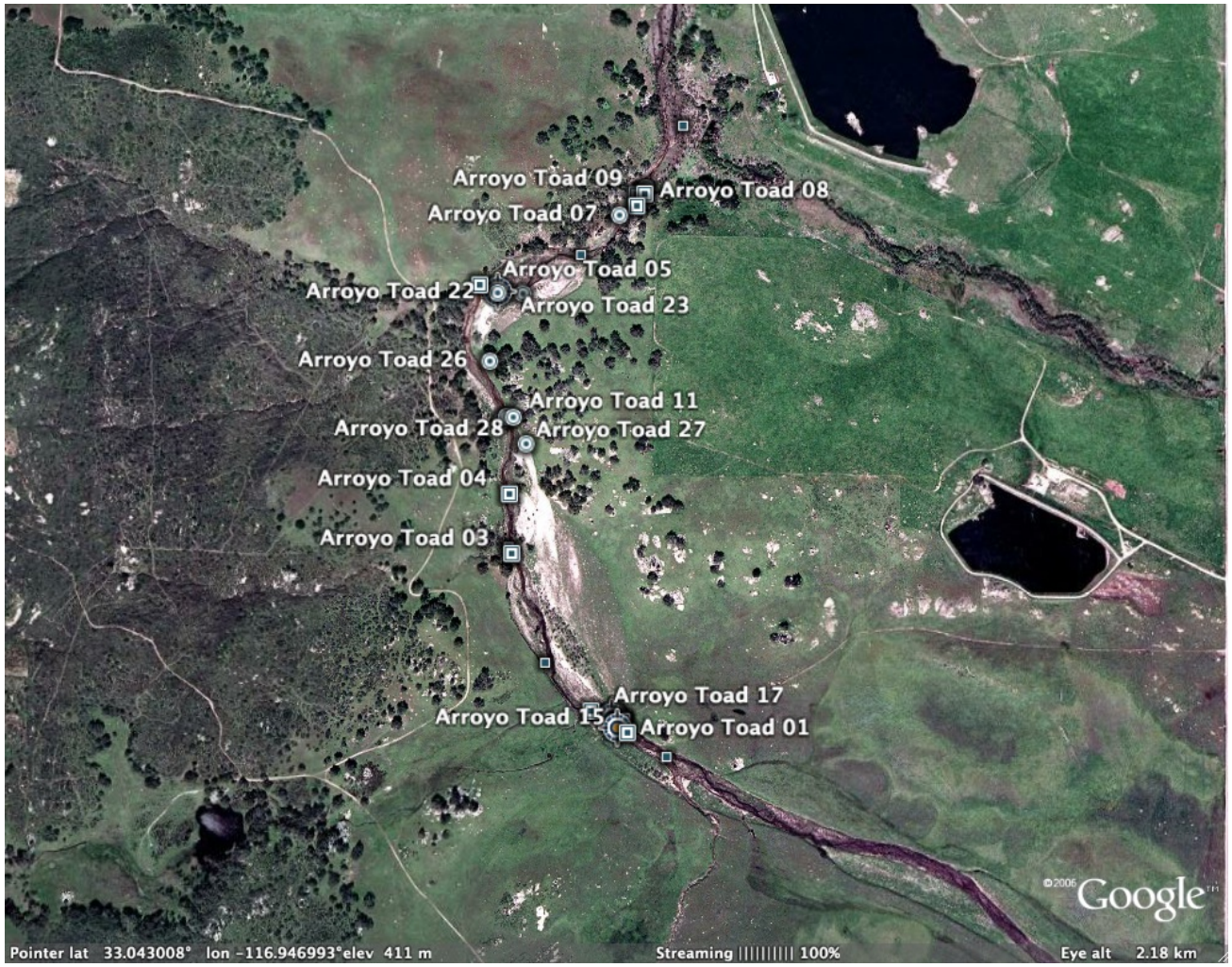


Figure 4. Map of the Preserve with survey stretches 1-5 (see Table 1) along the Santa Maria Creek showing locations of Arroyo Toad sightings.

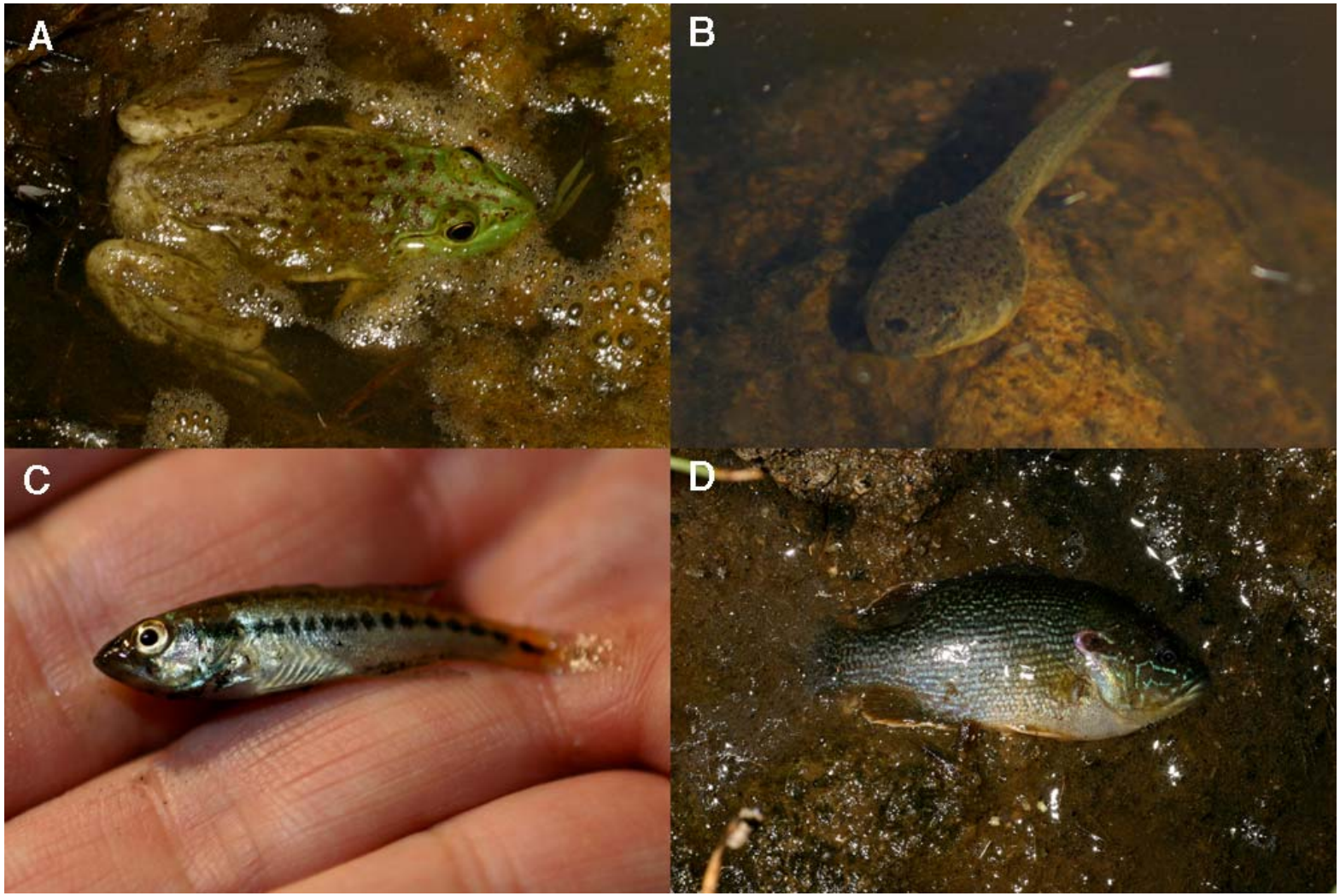


Figure 5. Exotic species observed during 2006 surveys: a) adult male bullfrog; b) bullfrog tadpole; c) largemouth bass; and d) green sunfish.

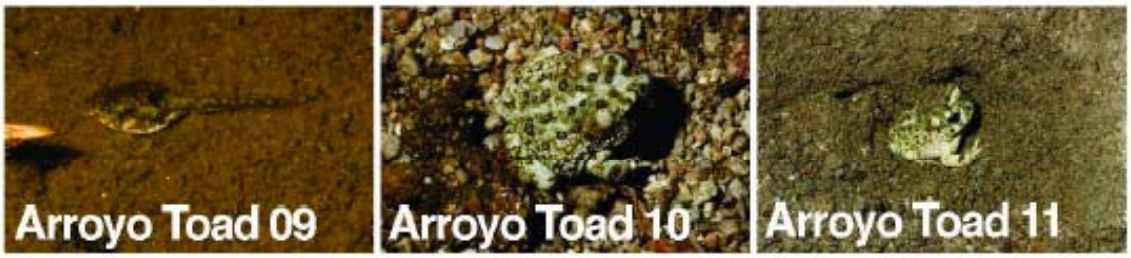
Appendix I

Data Sheet Example

Appendix II

Photographic Vouchers of Arroyo Toad Observations

(see Table 2 for specific data)



31 May 2006 Survey

Appendix II (continued)

Photographic Vouchers of Arroyo Toad Observations

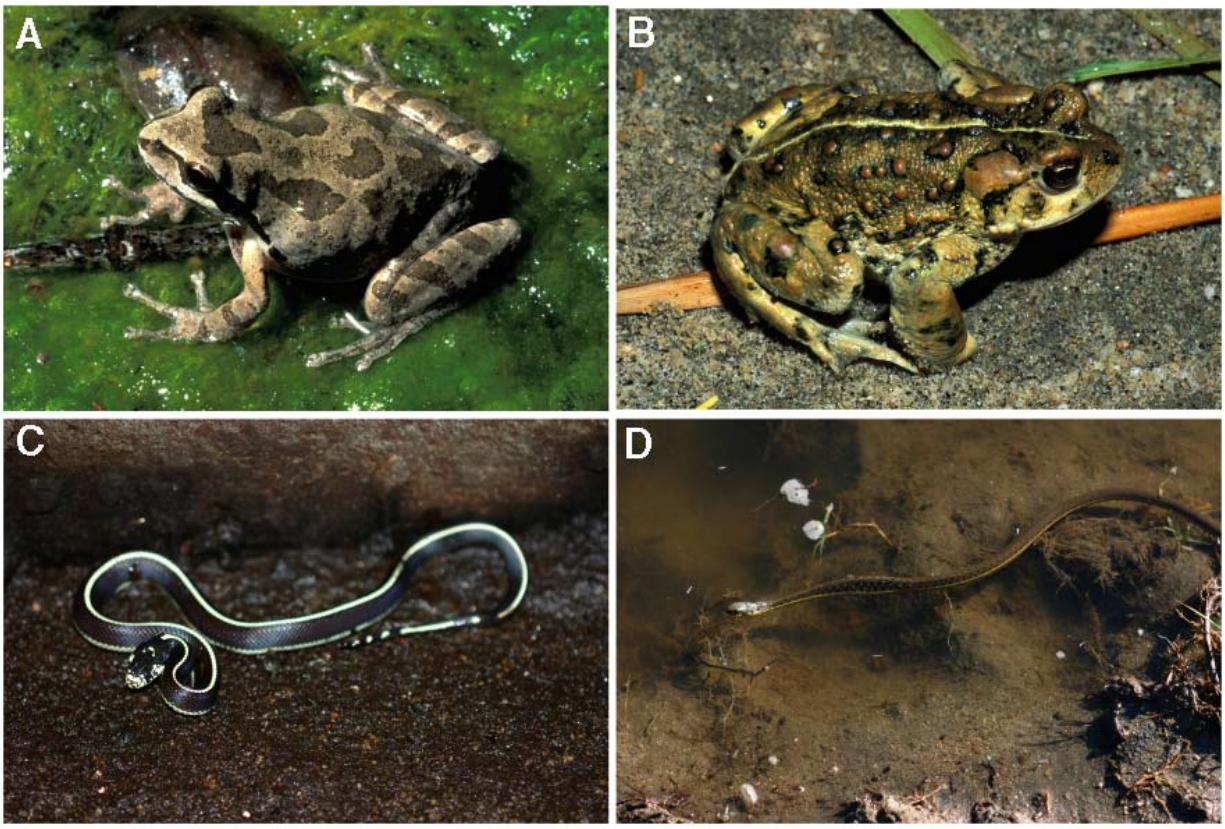
(see Table 2 for specific data)

12 June 2006 Survey

Appendix III

Native Species Seen At the Ramona Grasslands Preserve

A. *Pseudacris regilla*; B. *Bufo boreas*; C. *Lampropeltis getula*; D. *Thamnophis hammondii*



Species	Reach	Datum	UTM Region	UTM Easting	UTM Northing	Elevation (m)	Date
Bufo boreas	Reach #2	WGS84	11S	504770	3656140	395	12-Jun-2006
Lampropeltis getula	Reach #6	WGS84	11S	505971	3655026	412	12-Jun-2006
Pseudacris regilla	Reach #6	WGS84	11S	505971	3655026	412	31-May-2006
Pseudacris regilla	Reach $4	WGS84	11S	504904	3655682	400	12-Jun-2006
Thamnophis hammondii	Reach #6	WGS84	11S	505971	3655026	412	31-May-2006
Thamnophis hammondii	Reach #5	WGS84	11S	504962	3655675	405	12-Jun-2006